

CLAIMS

What is claimed is:

1 1. A method of opening an engine valve having a
2 hydraulic actuator to open the engine valve and a return
3 spring for closing the engine valve comprising:
4 coupling the hydraulic actuator to a source of fluid
5 under pressure to accelerate the engine valve toward the
6 engine valve open position;
7 continuing to couple the hydraulic actuator to the
8 source of fluid under pressure as the engine valve closing
9 force of the return spring starts to exceed the engine valve
10 opening force of the hydraulic actuator; and,
11 decoupling the hydraulic actuator from the source of
12 fluid under pressure as the engine valve stops at an engine
13 valve opening wherein the engine valve closing force of the
14 return spring exceeds the engine valve opening force of the
15 hydraulic actuator.

1 2. The method of claim 1 wherein the hydraulic
2 actuator is coupled to the source of fluid under pressure
3 through a pilot valve.

1 3. The method of claim 2 wherein the pilot valve is a
2 spool valve.

1 4. The method of claim 1 wherein the hydraulic
2 actuator is coupled to the source of fluid under pressure
3 through a proportional valve, the proportional valve being
4 hydraulically controlled by electrically controlled valving.

1 5. The method of claim 4 wherein the proportional
2 valve is a spool valve.

1 6. The method of claim 1 wherein the hydraulic
2 actuator and the return spring are coaxial with the engine
3 valve.

1 7. A method of opening an engine valve having a
2 hydraulic actuator to open the engine valve and a return
3 spring for closing the engine valve comprising:
4 coupling the hydraulic actuator to a source of fluid
5 under pressure to accelerate the engine valve toward the
6 engine valve open position;
7 continuing to couple the hydraulic actuator to the
8 source of fluid under pressure as the engine valve closing
9 force of the return spring starts to exceed the engine valve
10 opening force of the hydraulic actuator; and,
11 blocking flow to and from the hydraulic actuator as the
12 engine valve stops at an engine valve opening wherein the

13 engine valve closing force of the return spring exceeds the
14 engine valve opening force of the hydraulic actuator.

1 8. The method of claim 7 wherein the hydraulic
2 actuator is coupled to the source of fluid under pressure
3 through a pilot valve.

1 9. The method of claim 8 wherein the pilot valve is a
2 spool valve.

1 10. The method of claim 7 wherein the hydraulic
2 actuator is coupled to the source of fluid under pressure
3 through a proportional valve, the proportional valve being
4 hydraulically controlled by electrically controlled valving.

1 11. The method of claim 10 wherein the proportional
2 valve is a spool valve.

1 12. The method of claim 7 wherein the hydraulic
2 actuator and the return spring are coaxial with the engine
3 valve.

1 13. Engine valve apparatus comprising:
2 an engine valve;
3 an engine valve return spring disposed to urge the
4 engine valve to a closed position;
5 a source of fluid under pressure;

6 a hydraulic actuator disposed to urge the engine valve
7 to an open position;

8 valving for controllably coupling the source of fluid
9 under pressure to the hydraulic actuator, for blocking fluid
10 flow to and from the hydraulic actuator and for allowing
11 fluid flow from the hydraulic actuator to a vent; and,

12 a controller controlling the valving to couple the
13 source of fluid under pressure to the hydraulic actuator
14 until the engine valve stops at an engine valve opening at
15 which the return force urging the engine valve toward the
16 closed position exceeds the hydraulic force urging the engine
17 valve toward the open position, then blocking fluid flow to
18 and from the hydraulic actuator, and to allow fluid flow from
19 the hydraulic actuator to the vent when the engine valve is
20 to be closed.

1 14. The apparatus of claim 13 wherein the valving
2 couples the hydraulic actuator to the source of fluid under
3 pressure through an electrically controllable pilot valve.

1 15. The apparatus of claim 14 wherein the pilot valve
2 is a spool valve.

1 16. The apparatus of claim 13 wherein the valving
2 comprises a hydraulically controlled proportional valve and
3 electrically controllable valving, the hydraulic actuator

4 being coupled to the source of fluid under pressure through
5 the proportional valve, the proportional valve being
6 hydraulically controlled by the electrically controlled
7 valving.

1 17. The apparatus of claim 16 wherein the proportional
2 valve is a spool valve.

1 18. The apparatus of claim 13 wherein the hydraulic
2 actuator and the return spring are coaxial with the engine
3 valve.